

## **Value Stream Mapping within Green accounting: Opportunities and challenges**

**By**

**Karrar Abdullellah Azeez**

Department of Accounting, Najaf, University of Kufa, Faculty of Administration and Economics, Iraq.

**Ilham Abdul Hussein Abdul Mahdi**

Department of Accounting, Najaf, University of Kufa, Faculty of Administration and Economics, Iraq.

Email: [karara.alkhaldy@uokufa.edu.iq](mailto:karara.alkhaldy@uokufa.edu.iq)

### **Abstract**

This study tries to identify the opportunities and challenges of Green Value Stream Mapping integrated within green accounting for economic unities in a competitive business. Green Value Stream Mapping was used to improve operating performance because of the environmental and social opportunities. Firms have concerned with transforming materials and labor into goods and services as efficiently as possible to maximize production and profit. The analyzed results have Lighting this problem that companies must make a green design, better products, and improve the manufacturing processes. Green values Stream mapping has been used within accounting systems for improving operational performance. the most important conclusion shows The approach of green value stream mapping has improved measures that include eliminating the waste of resources, water, and energy, as well as using environmentally friendly resources.

**Keywords:** Value Stream Mapping; Green accounting, opportunities, challenges.

### **Introduction**

The agile approach is one of the modern methods of cost accounting, it has many tools for modern business such as the value stream map is undergoing rapid changes in all social, environmental and technological fields for reducing resources consumption. Driven by the possibility of reducing costs and reducing environmental impact, and thus the contribution of the agile approach to enhancing an environmental performance and integration with green accounting, as it called the green value stream mapping. The agile approach introduced the idea of reviewing production as a Stream and thus to the principle of eliminating losses to achieve the best result in the business, but it not enough to show the basic mechanism , how can it identify defects in the current work and to solve problems . The value stream mapping appeared within the green accounting for Focusing on the critical point firstly on the agile philosophy in 1995 (Chowdhury,2016). Value is created when internal losses are minimized as non-value adding processes and associated costs are reduced, increasing the overall value to the customer and the value also increases by providing additional features or services (Al-Rubaie, 2019). The Stream is defined as a continuous Stream of production to secure waiting times and processing times with no accumulated work, no unnecessary movement and diversion (Salloom& Sorour, 2022). Three main types of activities that affect the customer's perception of the value of the final product, the tasks that turn the product into what the customer desires, are value-added, the tasks that do not add value but are necessary, are not value-added, and the activities are necessary to create value and the customer will not pay ( Nazemi,2021) .

**Published/ publié in *Res Militaris* (resmilitaris.net), vol.13, n°1, Winter-Spring 2023**

Communication tool, business planning tool, and economic unit change management tool that documents current production waiting time, stock levels and cycle times to determine the percentage value added of the total waiting time of the product family at the moment creating an optimal value Stream proposition((Abdu ssamad etal.,2013).

This paper interested to show the new tool as green value stream mapping under opportunities and challenges, the green accounting is purposed for enhancing the competitiveness of the firms. As well as trying to control timing, waste, and consumption of cost elements through the method of internal and external factors. The research includes four parts, introduction. The developments of the green value stream mapping is second part. The third one is results and analysis. Conclusions is the fourth part.

### ***1. The developments of the green value stream mapping***

All the concepts, tools, and techniques have gone to many tests before accepted, in the same way a value-flow mapping has developed with the concept of agile thinking for internal and external benefits as follows:

The first stage:- Lean thinking appeared after World War .The Japanese industry, specifically in Toyota Motor Company, hit a number of problems represented by the difficulty of producing a large variety of products in order to fill the shortage in the Japanese domestic market. This period was characterized by a shortage of material, financial and human resources that afflicted The Japanese industry in that period, which prompted this economic unit represented by a number of its members to create a new system known today as the Lean Production System. The main idea behind the Lean system was to get rid of all waste, as the Toyota System 1 (TPS) is the basis that It is based on the philosophy of the agile approach(Shah& Ward,2007).

In the early fifties of the last century, lean production was worked out by Toyota in Japan based on concepts pioneered by Henry Ford (2) By 1965 Toyota was more efficient than famous American companies such as General Motors and Ford, but as a result of the emergence of several problems, Taiichi Ohno (3) worked on developing the Lean Production System (de Moura & Bonadio, 2021), and thus John is considered Krafcik<sup>4</sup> was the first to use the term "lean production" in a 1988 article The article was titled "The Triumph of Lean Production" and was based on a comparison of production systems for a group of different car manufacturers and the conclusion of this article was that systems Production like Toyota which has simple technology, low stocks, few warehouses can reach high levels of productivity and quality( Zhang,2017).

The term Lean Production System was coined and described in the 1990s by Womack and others in their book. The Machine that changes the world Lean production provides more production with fewer resources in order to reduce waste (Alwan&Rahman, 2018).The beginning of the value-stream mapping was in 1996. The term "value stream" was called by both Womack and Jones in their book Lean Thinking, They suggested to readers the term value-stream mapping without providing a detailed description of how it was implemented. It took until 1999 before this was done in Rather and Shook In this book John Shook states that in Toyota in the beginning the Value Stream Map of Regular Practice provided process maps or materials and information Stream diagrams to depict current and future operations. It was not a standardized method and was not used to guide the improvement process. However, it has evolved into a very important method in the current agile processes and continuous improvement cycle (Riezebos&Huisman,2019).

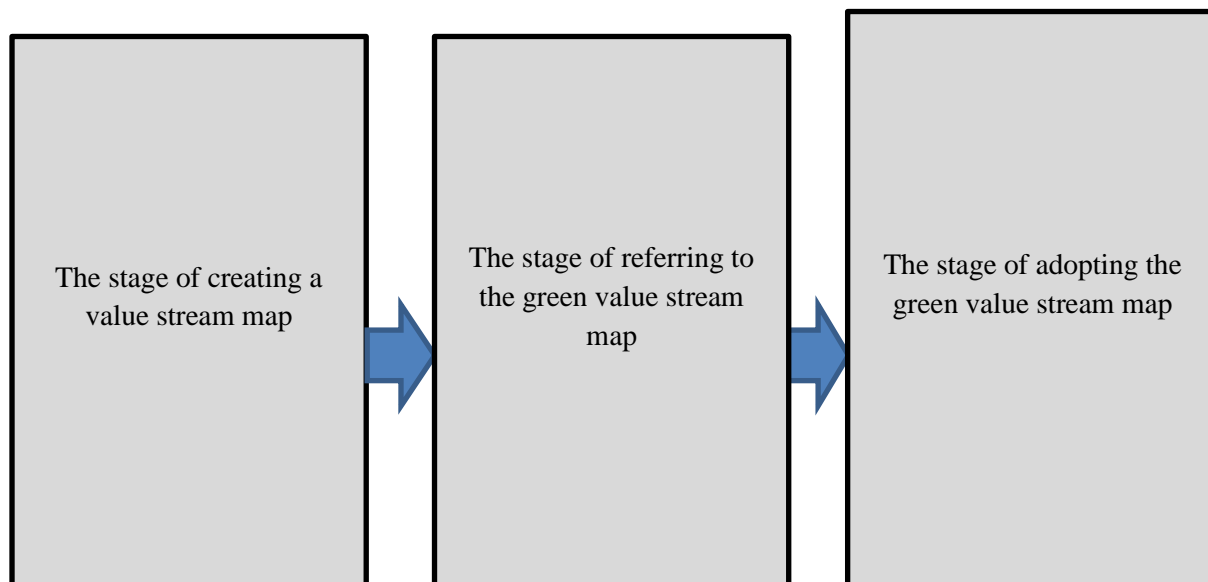
The second stage: The companies started to reduce the environmental waste resulting from their activities, as environmental concerns became a vital topic for most economic units. The Brundtland report was issued in 1987 in order to create a sustainable society and in 1990 The ISO14000 standard for environmental cost management was issued (Dadashzadeh & Wharton, 2012). The need to combine environmental waste with waste has emerged. One of the first attempts to combine sustainable (“green”) processes with agile dates back to 1996 and rethink the application and expansion of the agile approach in the context of the challenges of the modern global economy, which addressing for environmental sustainability and the challenge represented by the green operations that aim to reduce pollution and waste . The sustainable goal is not a profit, a customer but also for reducing negative environmental impacts (Rymaszewska, 2016).

Traditional value stream maps are a functional method or visual Stream diagram where a production process can be represented as a set of related processes in time. The method excels in showing the temporal dimension especially time not added or wasted and is thus the agile method of choice in industries where costs are mostly time dependent. VSM can assign an entire process, supply chain, or subtasks to a single process. It maps both the material and information flows that control production. The better integration is desirable between the time dimension as included in the traditional value stream map and the environmental waste dimension. Environmental metrics are only poorly considered in a traditional value-flow map, which tends to simply be concerned with the cost of raw materials or the decline in the productivity of the production system (Roosen, 2013).

From here, the economic units began to shift towards reducing waste and the need to integrate an environmental indicator in the value stream map to align their strategic objectives with operational objectives to achieve the best results (Whitman, 2006). In the context of efforts to develop traditional VSM and other agile technologies, the US Environmental Protection Agency (EPA) has made great efforts to expand the concept of the traditional value stream map (Folinas, 2014) Described as follows (Sparks, 2014) (Faulkner & Badurdeen, 2014)

The last stage: The adoption of the Green Value Stream Mapping approach is to support environmental goals appeared to be adopting. Given their increasing popularity, effectiveness, and relative simplicity, it is not surprising to see that some authors have considered using green agile tools to support environmental improvement and sustainable performance. This contribution is for helping organizations meet the sustainability challenges they currently face due to the growth in customer demands for greener products and services and compliance with environmental regulations Despite this important opportunity, research into this agile research path is still limited, especially when compared to the amount of A wealth of studies focusing on the traditional value stream map (VSM) found in the academic literature. To complement and support the narrow body of knowledge on the application of the VSM as a tool to promote environmental sustainability (Garza-Reyes, 2018).

Based on the foregoing, the Green Value Stream Map technology has efficiently achieved the integration of both production and environmental objectives. It is an agile technique that was originally applied in manufacturing to deal with production problems and then was adapted to manage environmental problems in manufacturing using an environmentally friendly approach. The figure (1) summarizes these three developing steps.



**Figure (1)** *the stages of green value stream mapping*

## **The results and analysis**

### **2. *The opportunities of Green Value Stream Mapping:***

A value stream map is one of the most important methods in agile production that uses symbols, matrices, and arrows to indicate and improve the Stream of inventory and information needed to make a product or service available to consumers (Venkataraman et al 2014). It includes both value-added and non-value-added activities. The main purpose of a value stream map is to understand the value stream, the cycle time for each activity, the entire value Stream schedule, the Stream of information from the customer through the production process, and the Stream of materials from the supplier through the production process to the customer. The goal of a value stream map is to quickly identify business problems in the context of the value stream and create solutions to solve them (Rahmi,2018). While Green Value Stream Maps are the traditional VSM plus time metrics that include environmental measures and environmental metrics for energy consumption, raw material use and processing (Lindström &Ingesson,2016). It has defined as the procedure for creating a green Stream map is very similar to the value stream map procedure. The initial structure of a supplier and customer diagram, value Stream activities and information Stream are identical It focuses only on green waste at each step and is not intended as a tool to make the process more agile.( Balinski,2011). It is a very important tool today to raise carbon efficiency and improve productivity and environmental performance at the same time(Zhu et al,2019).

Some researchers agree that a green value stream mapping includes activities and processes which may achieve economic value for firms as environmentally friendly. Based on final goals set by (Dadashzadeh &Wharton,2012 „Patil,2005,Balinski,2011):

- ❖ Providing manufactured products that use processes that reduce negative environmental impacts, conserve energy and natural resources, are safe for employees, communities and consumers, and are safe
- ❖ Providing materials with low environmental impact, i.e. environmentally friendly raw materials, not using toxic or hazardous materials, and using recyclable materials.
- ❖ -Designing production processes to reduce waste, an area where waste can be eliminated through more agile transportation and packaging of goods. The concept of

green manufacturing has entered the agenda as a response to the negative environmental impacts caused by manufacturing activities.

- ❖ Maximizing the energy and water efficiency that can be achieved, including inventory control, which reduces the space required in the facility and thus reduces heating, cooling and energy costs
- ❖ Identifying where the environmental impacts occur in the production line.
- ❖ Determining the amount of raw materials used by operations and comparing them with the materials actually needed to produce the product
- ❖ Identification of pollution and waste resulting from production activities Identification of the root causes of waste and deficiencies
- ❖ Reducing pollution in the process rather than treating it at the end of the line will reduce the amount of environmental waste. The lean approach encourages a highly sensitive operational and cultural environment by reducing waste and minimizing environmental factors that have serious impacts on the environment.

### 3. *The practical advantages of Green Value Stream Mapping:*

The value stream map provides a set of benefits for economic unities set by (Whitman et al,2006, Garza-Reyes et al,2018 ,Roosen,2013 , Patil,2005(

- ❖ Reducing inventory levels (raw materials, work-in-progress, finished product) along with transportation costs and associated losses due to spoilage, spoilage, and non-conformity
- ❖ Reducing the materials consumption (product inputs, including energy, water, minerals, chemicals, etc.) by reducing material requirements and creating less waste during manufacturing
- ❖ Optimizing an equipment utilization (capital equipment used for production and direct support purposes) by using low-capital and resource-intensive machinery to reduce costs
- ❖ Reducing the need for economic unit facilities (mainly physical infrastructure in the form of buildings and associated material requirements) by reducing the space required to produce the product
- ❖ Increasing production speed (the time required to process a product from raw materials to delivery to the consumer) by eliminating process steps, movement, waiting times and downtime
- ❖ Enhancing production flexibility (the ability to quickly change or reconfigure products and processes to adapt to customer needs and changing market conditions) by enabling the implementation of a production pull-down, time-oriented system that reduces inventory and capital requirements
- ❖ Reducing complexity (complex products and processes that increase opportunities for variance and error) by reducing the number of parts and types of materials in products, and by eliminating unnecessary process steps and equipment with unnecessary features
- ❖ Helping a managers to visualize multiple operations simultaneously, which gives a better overall picture of the institution
- ❖ Providing a form of basis for an implementation plan by providing opportunities for improvement and making improvement decisions easier
- ❖ Looking at the same and this provides a common language to talk about manufacturing processes across the economic unit
- ❖ Making a better linking between the Stream of information and the stream of materials.

#### 4. *The features of green value stream mapping*

The value flow is the theoretical basis for agile production; It is the entire activity that a product or service performs throughout the production process, including adding value to the product and not adding value. In this paper, the features show as the differences between the value stream mapping and the green value flow mapping as follows. (Villamizar et al,2019,Kurdve et al,2011, Roosen& Pons,2013,Garza-Reyes et al,2018, Shalash & Abbas,2015):

**Table(1)** *the differences between traditional and green value stream mappings*

Item	Traditional Value Stream Mapping	Green Value Stream Mapping
1 Purpose	Focuses on enhancing competitiveness by creating value for clients. Quality, waste minimization/elimination and delivery times are key issues	Focused on incorporating environmental improvements to industrial processes and products. Reducing or preventing pollution of air, water and land Reducing waste at the source and minimizing risks to humans and other types are key issues
2 Basic principles	It includes a number of principles relating to four categories: philosophy (long-term thinking), process (eliminating waste), people and partners (respect, challenge and development), and problem solving (continuous improvement and learning).	Principles relating primarily to three categories include: pollution prevention, reduction of toxic use, and design for the environment.
3 Focusing	Focused primarily on operations, but the impact of products on operations performance is well recognized.	Focuses on both processes and products
4 Time cycle	Reduce waiting time as long as it does not increase cost	Reduces waiting time for transportation as long as it does not increase CO2 emissions
5 the market Stage	Serving only current market segments, with expected demand	Calling for more environmentally friendly practices.
	<b>Implementation steps</b>	
Firstly, planning	Determining the family of the product by indicating the value-added or non-value-added activities	Including defining strategic goals, informing employees of the structure and importance of the green map, and collecting data in order to discover the sources of environmental waste and the way to eliminate them.
Secondly, implementation	Building a value-stream map of the existing case	which includes designating the implementation team, selecting the product family, determining the stages of the value flow, determining and measuring environmental waste in the value flow
Thirdly, reviewing	Build a futuristic map, redesign value paths, eliminate waste and suggest improvements	begins by analyzing, removing or reducing waste, and creating a green value stream map for the future state
Fourthly, Correction	The stage of work and implementation	which is formulating a plan to implement the future green value flow map and implementing the plan

## 5. *The challenges of green value stream mapping*

All practices that are applied recently must create challenges, there is a need to investigate the obstacles that affect the implementation of these practices for the purpose of knowing these barriers and obstacles and working to reduce their impact or remove them permanently. These barriers and obstacles are as follows (Singh et al, 2020):

**Lack of environmental knowledge.** These days although the environment has attracted the attention of decision makers in manufacturing processes, industrialists, scientists and even consumers in different parts of the world. However, it has been emphasized in some studies that environmental knowledge is not a sufficient component of positive environmental behavior. Environmental issues are important because the lack of answers to them is even more terrifying. Unless environmental problems are resolved or not taken care of, future generations may find that the Earth is not worth living. Lack of knowledge of the environment appears to be a major barrier to implementing green agile practices

**Senior management.** The lack of senior management commitment is a major obstacle to the successful implementation of Green Practices. Implementing green channel practices requires a competent management leader. The willpower of senior management is the most important. There is an urgent need to constantly motivate employees to adopt new practices in the manufacturing process. If the top management shows good commitment, the manufacturing sector will be able to implement the Green Value Stream Map effectively. Green agile applications in particular require the active involvement of top management in the manufacturing industry that top management must constantly monitor and evaluate the importance of the business unit in how the business unit environment helps create a green channel. In addition, it should track how internal regulatory factors require or undermine the introduction of green practices and respond accordingly.

**Resistance/fear of change.** Resistance to change is a system's reluctance to continue its current behavior, despite any use of pressure to change those attitudes. Economic unit employee shows resistance to any changes in daily routine work and also comes unease among them due to unexpected output. The resistance associated with the existence of values that make it difficult to change all this remains unchanged. Resistance to change is an important factor in any change process as proper management of resistance is the key to change success or failure.

**Financial constraints.** Implementing the Green Value Stream Map requires an initial investment which is very risky for every manager. Lack of financial resources may create obstacles in implementing new policies. Profit-making has always been prioritized by many businesses. Lack of financial resources is a significant obstacle mentioned by many previous studies. Financial constraints are an important constraint, especially for small businesses.

**Lack of staff training.** To implement the Green Value Stream Map, there is a need for proper training and knowledge of both managers and employees. Training may play a key role in developing organizational skills and knowledge in it. There is an urgent need for training to make industries more resource efficient and environmentally sustainable. Ongoing training should be provided to employees to implement the Green Value Stream Map for the purpose of its implementation. Proper knowledge and training is required for both managers and employees.

**Insufficient government support.** For the proper functioning of any enterprise including the environment in which it operates, legislation and regulation are very essential. Manufacturing industries must operate in accordance with environmental laws and regulations

and these laws can be changed by political factors of states. Fairly rapid political changes in a particular region can be disastrous for any attempts at reform in these directions. Government assistance may promote appropriate policies to replace obsolete technology by arranging certain subsidies and other benefits. Likewise, the government may encourage green value-flow policy education initiatives.

Technological obstacles. Evolution may bring about a change in technical factors in many features in the processes, but this technology development requires integration processes, care and skilled manpower to manage it. Different types of technologies in computer-aided manufacturing or computer-aided design and robotics need skilled manpower to manage things. This barrier arises from the use of redundant technology and highly skilled labor.

Lack of good communication. Having good communication skills is very useful in a work environment. Health communication skills convey their accurate message and reduce problems in implementing new policies such as the Green Value Stream Map. On the contrary, the lack of effective communication skills is detrimental to the confidence of workers. Employees need to be appropriately informed of changes in the context of the agile practices being implemented. The use of the Green Value Stream Map includes effective communication, team management and coordination at various levels. Therefore, the lack of a good connection may impair its use.

Lack of a dedicated resource. Collective strategic actions involving all members of the supply chain will lead to the successful implementation of the Green Value Stream Map towards competitiveness. Suppliers' reluctance to switch to this initiative is due to their conventional thinking. It may provide suppliers with rewards and incentives to create more stringent ecosystems and promote agile green strategies. Suppliers may act as a cohesive component of the organization in order to survive and grow in a competitive environment.

Lack of proper planning system. Before implementing the Green Value Stream Map it is helpful to have good work experience whose skills may provide the basis for the success of its results. Each method and activity for its implementation should be clear and well defined to research the specific knowledge required for its operations. Each activity should be carried out in accordance with the guidelines laid down in the context of agile initiatives. It has been stated that there is a lack among industries in applying appropriate product planning and setting environmentally friendly performance standards. Moreover, he also introduced that in Lean initiatives it is important to plan correctly, that is, if a task is supposed to finish on a certain day, it should not be paid for the next day, but may cause a disastrous situation for the economic unit.

Lack of awareness about the potential benefits. Some studies claim that if new initiatives are demonstrated to participants, they are interested in implementing them. Indicators of the degree of improvements also encourage stakeholders. Hence, if the potential benefits of the Green Value Stream Map are not clear to managers and employees, it will present an obstacle to its implementation and a lack of understanding of its potential benefits will create a negative attitude across employees.

Lack of positive culture: "The culture of economic loneliness can be defined as a norm and behaviors that cover trust, hierarchy, work environment, and feeling for others." Organizational culture is an organization's belief system, including ways of working, rituals, anecdotes, and appropriate ways to achieve industry goals. The culture of any industry affects performance because it influences human behavior. If the culture of analyzing the economic



unit barriers does not support, the organizational culture needs to change, and the friendly organizational culture may be an encouragement to adopt the green value stream map. On the other hand, if there is a lack of trust and cooperation in the economic unit, this type of culture may become an obstacle in its application.

## Conclusions

This study tries to identify the opportunities and challenges of Green Value Stream Mapping integrated within green accounting for economic unities in competitive business. Green Value Stream Mapping has many opportunities which can improve an operating performance depended on green raw materials time maps, and job schedules. The Green Value Stream Map has been illustrated by the US Environmental Protection Agency for providing a new model as environmental losses. The process improvement measures that have been found include eliminating the waste of resources, water and energy as well as using environmentally friendly resources. There are very few studies on the green value stream mapping compared to the implementation procedures should be increased.

## References

1. Alwen, A. P. D. S. A. (2020). Design a lean production system by using the simulation method: case study at the Specialist child Hospital in Basra. *Managerial Studies Journal*, 12(25).
2. Babinski, K. D. (2011). Quantifying the carbon footprint of lean waste.
3. Chowdhury, M. M. (2016). Simulation of value stream mapping and discrete optimization of energy consumption in modular construction. Illinois State University.
4. Dadashzadeh, M. D., & Wharton, T. J. (2012). A value stream approach for greening the IT department. *International Journal of Management & Information Systems (Ijmis)*, 16(2), 125-136.
5. de Moura, D. A., & Bonadio, V. C. (2021). Service value stream management (SVSM)-a case study. *Independent Journal of Management & Production*, 12(4), 832-855.
6. Faulkner, W., & Badurdeen, F. (2014). Sustainable Value Stream Mapping (Sus-VSM): methodology to visualize and assess manufacturing sustainability performance. *Journal of cleaner production*, 85, 8-18.
7. Folinas, D., Aidonis, D., Malindretos, G., Voulgarakis, N., & Triantafillou, D. (2014). Greening the agrifood supply chain with lean thinking practices. *International Journal of Agricultural Resources, Governance and Ecology* 6, 10(2), 129-145.
8. Garza-Reyes, J. A., Romero, J. T., Govindan, K., Cherrafi, A., & Ramanathan, U. (2018). A PDCA-based approach to environmental value stream mapping (E-VSM). *Journal of Cleaner Production*, 180, 335-348.
9. Heizer, J., Render, B., Munson, C., & Sachan, A. (2017). *Operations management: sustainability and supply chain management*, 12/e.
10. Inman, R. A., & Green, K. W. (2018). Lean and green combine to impact environmental and operational performance. *International Journal of Production Research*, 56(14), 4802-4818.
11. Kurdve, M., Hanarp, P., Chen, X., Qiu, X., Zhang, Y., Stahre, J., & Laring, J. (2011, May). Use of environmental value stream mapping and environmental loss analysis in lean manufacturing work at Volvo. In *Proceedings of the 4th Swedish Production Symposium (SPS11)* (pp. 3-5).
12. Lindström, V., & Ingesson, N. (2016, September). Mapping a Value Stream with the Perspective of Sustainability. In *IFIP International Conference on Advances in*

- Production Management Systems (pp. 892-899). Springer, Cham.
13. I-Rubaie. Bushra Abdel Hamza Abbas. (2019). "Designing a Lean Manufacturing System Using a Value stream map and its Impact on Productivity Improvement." Ph.D. thesis. College of Administration and Economics, University of Karbala, Iraq
  14. Muñoz-Villamizar, A., Santos, J., Garcia-Sabater, J. J., Lleo, A., & Grau, P. (2019). Green value stream mapping approach to improving productivity and environmental performance. *International Journal of Productivity and Performance Management*.
  15. Nazemi, Z. (2021). Value Stream Mapping for Formation of Product Families (Doctoral dissertation, University of Windsor (Canada)).
  16. Ng, R., Low, J. S. C., & Song, B. (2015). Integrating and implementing Lean and Green practices based on proposition of Carbon-Value Efficiency metric. *Journal of Cleaner Production*, 95, 242-255.
  17. Norton, A., & Fearn, A. (2009). Sustainable value stream mapping in the food industry. In *Handbook of waste management and co-product recovery in food processing* (pp. 3-22). Woodhead Publishing.
  18. Patil, A. S. (2005). Incorporating environmental index as waste into value stream mapping. Wichita State University.
  19. Plehn, J., Sproedt, A., Gontarz, A., & Reinhard, J. (2012). From strategic goals to focused eco-efficiency improvement in production: bridging the gap using environmental value stream mapping. In 10th Global Conference of Sustainable Manufacturing (GCSM 2012). Eidgenössische Technische Hochschule Zürich, Institute of Machine Tools and Manufacturing (IWF).
  20. Rahmi, U. (2018). DESAIN GREEN LEAN MANUFACTURING DENGAN METODE ENVIRONMENTAL VALUE STREAM MAPPING (EVSM) UNTUK MEREDUKSI ENVIRONMENTAL WASTE (STUDI KASUS: CV SOGAN BATIK REJODANI).
  21. Riezebos, J., & Huisman, B. (2020). Value stream mapping in education: addressing work stress. *International Journal of Quality & Reliability Management*.
  22. Roosen, T. J. (2013). Reducing Lean and Environmental Wastes: The Integration of Value Stream Mapping with Environmental Wastes to Improve Production, Performance, Efficiency and Process Flow.
  23. Rymaszewska, A. D. (2016). Rethinking the applicability of lean philosophy: a conceptual and empirical analysis.
  24. Salloom, R. S., & Sorour, M. J. (2022). The Role of Lean Production in Reducing Environmental Costs Case Study in the Company of Oil Products' Distribution. *Tikrit Journal of Administration and Economics Sciences*, 18(57 part 1).
  25. Samad, M. A., Saiful Alam, M. D., & Tusnim, N. (2013). Value stream mapping to reduce manufacturing lead time in a semi-automated factory. *Asian Transactions on Engineering*, 2(06), 22-28.
  26. Shah, R., & Ward, P. T. (2007). Defining and developing measures of lean production. *Journal of operations management*, 25(4), 785-805
  27. Shalash, F. J., & Abbas, T. H. (2015). The employing of lean manufacturing in Service Redesign A case study In Al-Diwaniya educational hospital. *AL-Qadisiyah Journal For Administrative and Economic sciences*, 17(2).
  28. Singh, C., Singh, D., & Khamba, J. S. (2020). Analyzing barriers of Green Lean practices in manufacturing industries by DEMATEL approach. *Journal of Manufacturing Technology Management*.
  29. Sparks, D. T. (2014). Combining sustainable value stream mapping and simulation to assess manufacturing supply chain network performance.
  30. Venkataraman, K., Ramnath, B. V., Kumar, V. M., & Elanchezhian, C. (2014).

- Application of value stream mapping for reduction of cycle time in a machining process. *Procedia Materials Science*, 6, 1187-1196.
31. Whitman, L. E., Twomey, J., & Patil, A. (2006). Greening the value stream: towards an environmental index. *IFAC Proceedings Volumes*, 39(4), 109-113.
  32. Zhang, H. (2017). *Three Studies on Lean Implementation in US Hospitals* (Doctoral dissertation, University of Toledo)
  33. Zhu, X. Y., Zhang, H., & Jiang, Z. G. (2020). Application of green-modified value stream mapping to integrate and implement lean and green practices: A case study. *International Journal of Computer Integrated Manufacturing*, 33(7), 716-731.